

CLAIMS

What is claimed is:

1. A die cushion apparatus for use in a stretch-forming process involving heated tooling, said die cushion apparatus comprising:
 - a lower plate;
 - an upper plate that undergoes different thermal expansion than said lower plate; and
 - a plurality of guidance devices mounted between said upper and lower plates, said plurality of guidance and including:
 - a guide post;
 - a bearing sleeve circumscribing at least a portion of said guide post; and
 - a cylinder circumscribing at least a portion of said bearing sleeve;

wherein one of said guide post and said cylinder is mounted in fixed relation to one of said upper and lower plates, and the other of said guide post and said cylinder is mounted in laterally translatable relation to the other of said upper and lower plates to accommodate lateral relative displacement between said upper and lower plates due to different thermal expansion thereof, thereby preventing binding of said plurality of guidance devices.
2. The die cushion apparatus as recited in claim 1, wherein said upper and lower plates include corners and substantially opposed sides, further wherein said plurality of guidance devices are positioned laterally along said sides of said upper and lower plates and not at said corners of said upper and lower plates.

3. The die cushion apparatus as recited in claim 2, wherein said plurality of guidance devices are positioned substantially at midpoints along said sides of said upper and lower plates.

4. The die cushion apparatus as recited in claim 3, wherein said plurality of guidance devices include two opposed pairs of guidance devices, each of said two opposed pairs being substantially aligned along a respective centerline of said die cushion apparatus along a respective axis.

5. The die cushion apparatus as recited in claim 1, wherein said cylinder is translatable mounted to said lower plate.

6. The die cushion apparatus as recited in claim 5, wherein said plurality of guidance devices further include a rectangular mounting block having a mounting flange that is fastened to said lower plate, wherein said cylinder is mounted within said rectangular mounting block and is laterally translatable therein.

7. The die cushion apparatus as recited in claim 5, wherein said plurality of guidance devices further includes a mounting flange attached to said cylinder and mounted against said lower plate and retainer blocks that are attached to said lower plate and that loosely capture said mounting flange therebetween to permit said cylinder to be laterally translatable with respect to said lower plate.

8. The die cushion apparatus as recited in claim 5, wherein said lower plate includes at least one aperture therethrough, and said plurality of guidance devices further includes a T-shaped mounting flange attached to said cylinder and mounted against said lower plate and extends at least partially through said at least one aperture of said lower plate, said plurality

of guidance devices further includes retainer blocks that are attached to said lower plate and that loosely capture said T-shaped mounting flange therebetween to permit said cylinder to be laterally translatable with respect to said lower plate.

9. A self-contained die cushion assembly for use in a stretch-forming process involving heated tooling, said self-contained die cushion assembly comprising:

a lower plate having corners and sides;

an upper plate that undergoes different thermal expansion than said lower plate, said upper plate having corners and sides; and

a plurality of guidance devices mounted between said upper and lower plates, said plurality of guidance devices being positioned substantially at midpoints of said sides of said upper and lower plates and not at said corners of said upper and lower plates, said plurality of guidance devices including:

a guide post;

a bearing sleeve circumscribing at least a portion of said guide post; and

a cylinder circumscribing at least a portion of said bearing sleeve;

wherein said guide post is mounted in fixed relation to said upper plate, and said cylinder is mounted in laterally translatable relation to the said lower plate to accommodate lateral relative displacement between said upper and lower plates due to different thermal expansion thereof from heat generated by said heated tooling, thereby preventing binding of said guide post within said cylinder.

10. The self-contained die cushion assembly as recited in claim 9, wherein said plurality of guidance devices further include a rectangular

mounting block having a mounting flange that is fastened to said lower plate, wherein said cylinder is mounted within said rectangular mounting block and is laterally translatable therein.

11. The die cushion apparatus as recited in claim 9, wherein said plurality of guidance devices further includes a mounting flange attached to said cylinder and mounted against said lower plate and retainer blocks that are attached to said lower plate and that loosely capture said mounting flange therebetween to permit said cylinder to be laterally translatable with respect to said lower plate.

12. The die cushion apparatus as recited in claim 9, wherein said lower plate includes at least one aperture therethrough, and said plurality of guidance devices further includes a T-shaped mounting flange attached to said cylinder and mounted against said lower plate and extends at least partially through said at least one aperture of said lower plate, said plurality of guidance devices further includes retainer blocks that are attached to said lower plate and that loosely capture said T-shaped mounting flange therebetween to permit said cylinder to be laterally translatable with respect to said lower plate.

13. A guidance device for mounting between upper and lower plates of a die cushion apparatus for a hot stretch-forming process wherein said upper plate undergoes different thermal expansion than said lower plate, said guidance device including:

a guide post;

a bearing sleeve circumscribing at least a portion of said guide post; and

a cylinder circumscribing at least a portion of said bearing sleeve;

wherein one of said guide post and said cylinder is mounted in fixed relation to one of said upper and lower plates, and the other of said guide post and said cylinder is mounted in laterally translatable relation to the other of said upper and lower plates to accommodate lateral relative displacement between said upper and lower plates due to different thermal expansion thereof, thereby preventing binding of said guide post within said cylinder.

14. The guidance device as recited in claim 13, wherein said cylinder is translatably mounted to said lower plate.

15. The guidance device as recited in claim 14, further including a rectangular mounting block having a mounting flange that is fastened to said lower plate, wherein said cylinder is mounted within said rectangular mounting block and is laterally translatable therein.

16. The guidance device as recited in claim 14, further including a mounting flange attached to said cylinder and mounted against said lower plate and retainer blocks that are attached to said lower plate and that loosely capture said mounting flange therebetween to permit said cylinder to be laterally translatable with respect to said lower plate.

17. The guidance device as recited in claim 14, wherein said lower plate includes at least one aperture therethrough, and said guidance device further includes a T-shaped mounting flange attached to said cylinder and mounted against said lower plate and extends at least partially through said at least one aperture of said lower plate, said guidance device further includes retainer blocks that are attached to said lower plate and that loosely capture said T-shaped mounting flange therebetween to permit said cylinder to be laterally translatable with respect to said lower plate.